

US008726267B2

(12) **United States Patent**
Li et al.

(10) **Patent No.:** **US 8,726,267 B2**
(45) **Date of Patent:** ***May 13, 2014**

(54) **SHARING SOFTWARE CERTIFICATION AND PROCESS METADATA**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1421 days.

This patent is subject to a terminal disclaimer.

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(21) Appl. No.: **11/387,705**

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(22) Filed: **Mar. 24, 2006**

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(65) **Prior Publication Data**

US 2007/0240152 A1 Oct. 11, 2007

(57) **ABSTRACT**

(51) **Int. Cl.**
G06F 9/44 (2006.01)

(52) **U.S. Cl.**
USPC **717/173**

(58) **Field of Classification Search**
USPC 717/101–103, 120–123, 168–178, 115,
717/124; 713/154–158, 172–175, 1;
375/352; 709/223, 233; 710/36;
702/185; 707/200, 1, 999.001, 999.104
IPC G06F 8/65
See application file for complete search history.

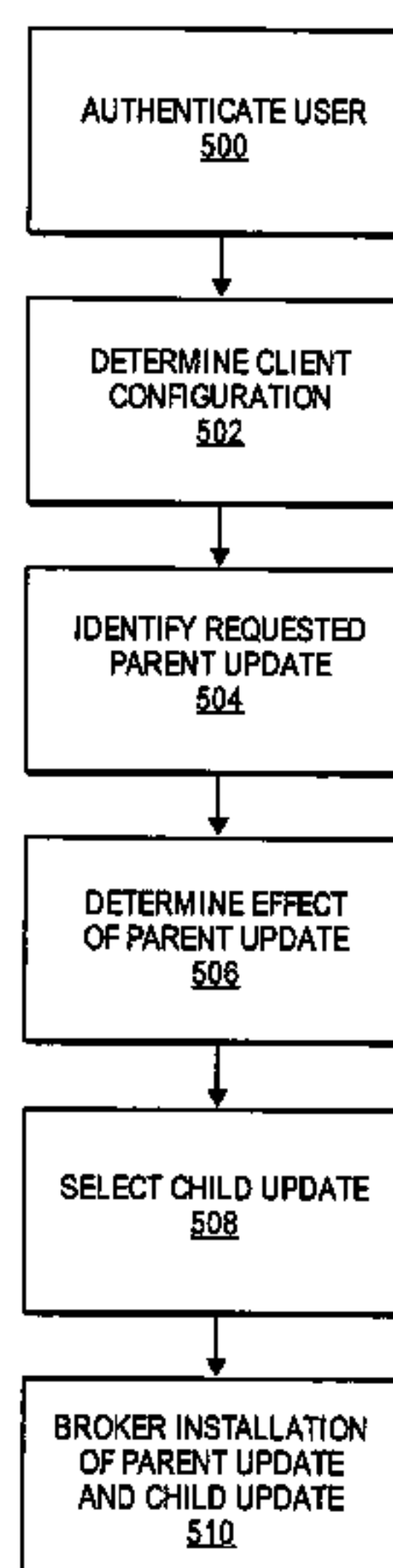
A management service is provided for maintaining software of one or more users, or an enterprise. On behalf of users or enterprises, the management service collects supplemental metadata about the certification and updates of software as well as processes related to the development and testing of the software. Supplemental metadata relates to any information that qualitatively describes the software outside of its basic operations. Each piece of supplemental metadata may be individually authenticated to ensure its accuracy. In addition, pieces of supplemental metadata can be combined with other supplemental metadata. Accordingly, a user or system administrator may then use various policies to manage software and determine which updates to install based on the supplemental metadata in addition to the typical intrinsic metadata, such as dependency information.

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25 Claims, 6 Drawing Sheets



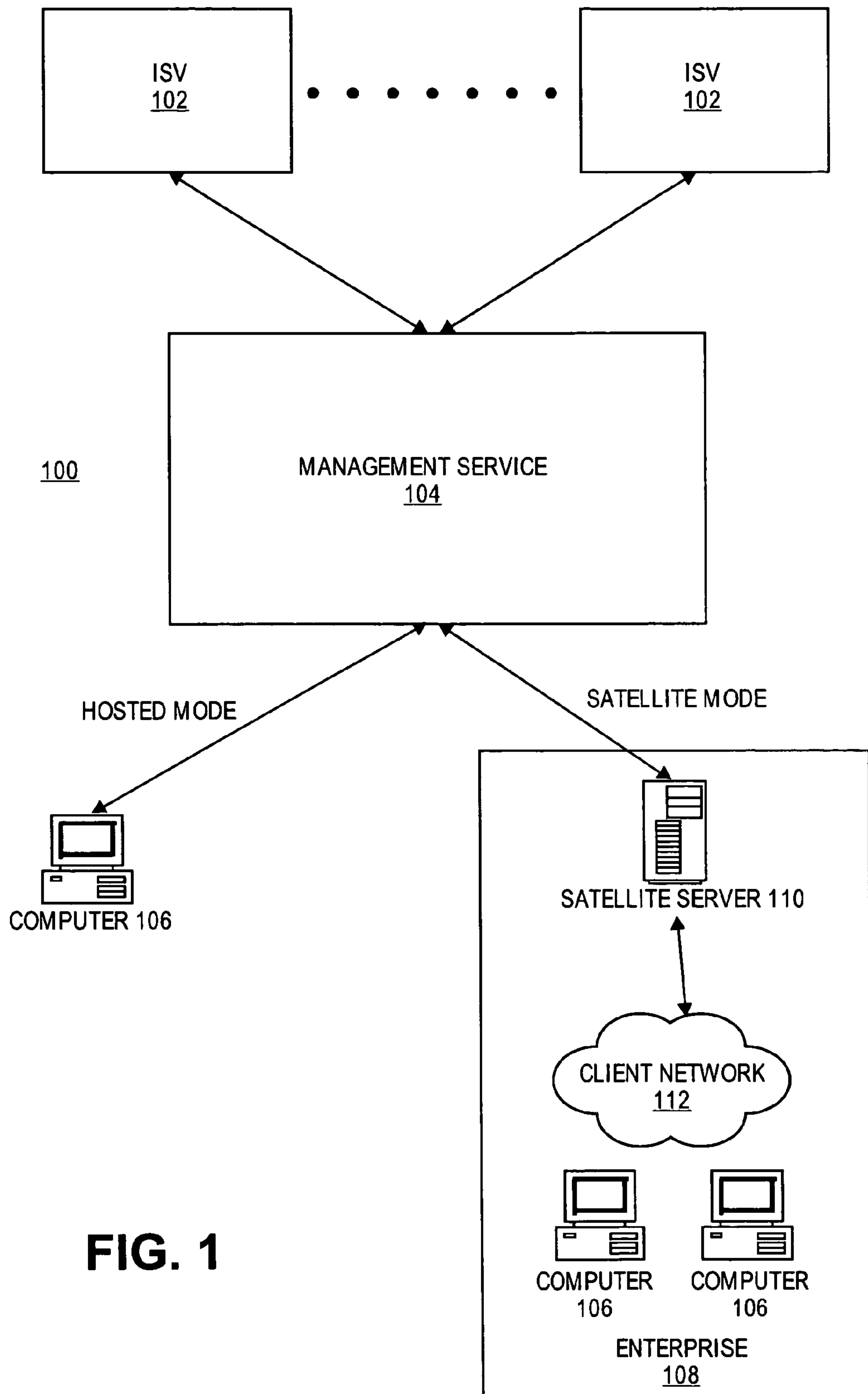


FIG. 1

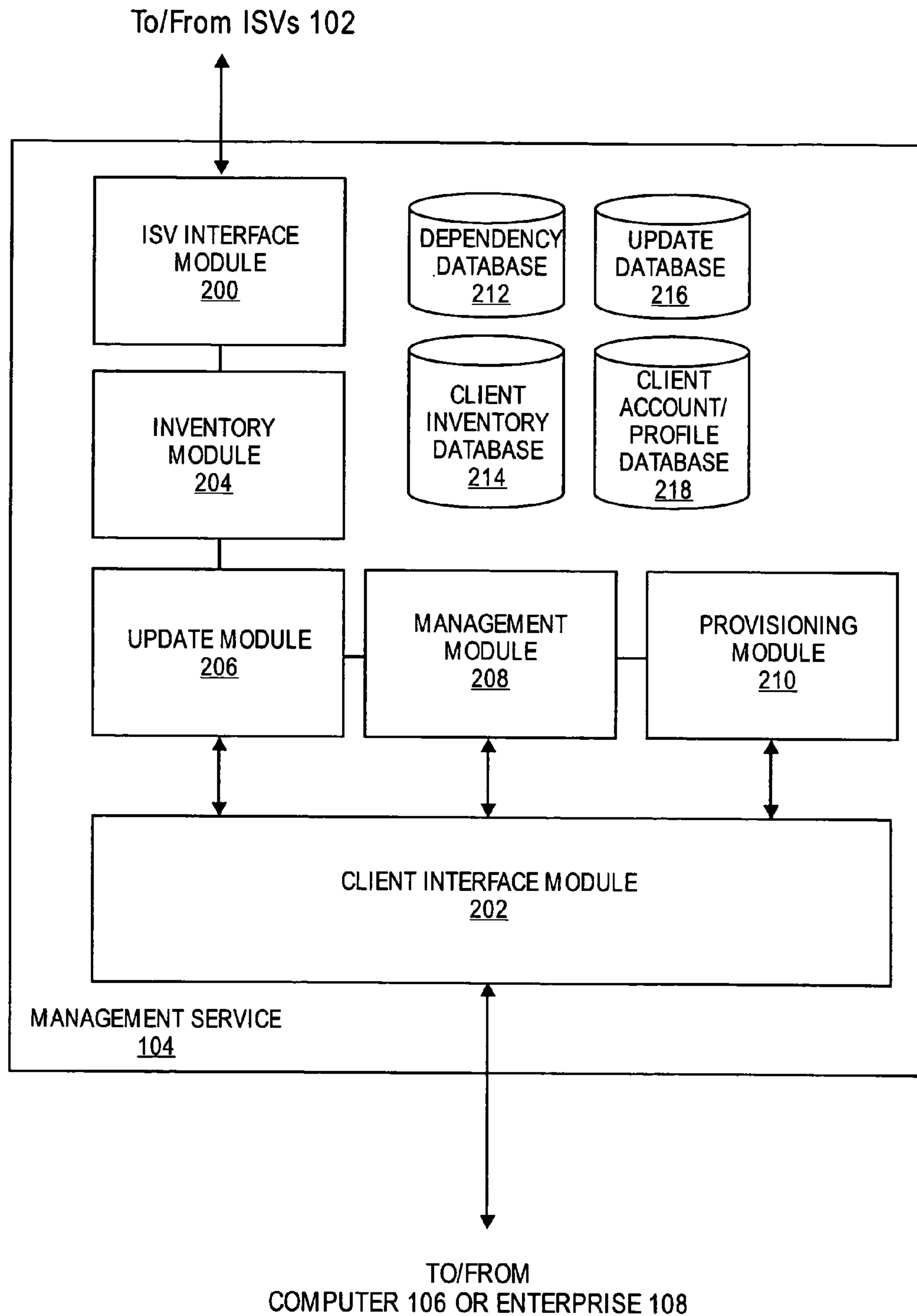


FIG. 2

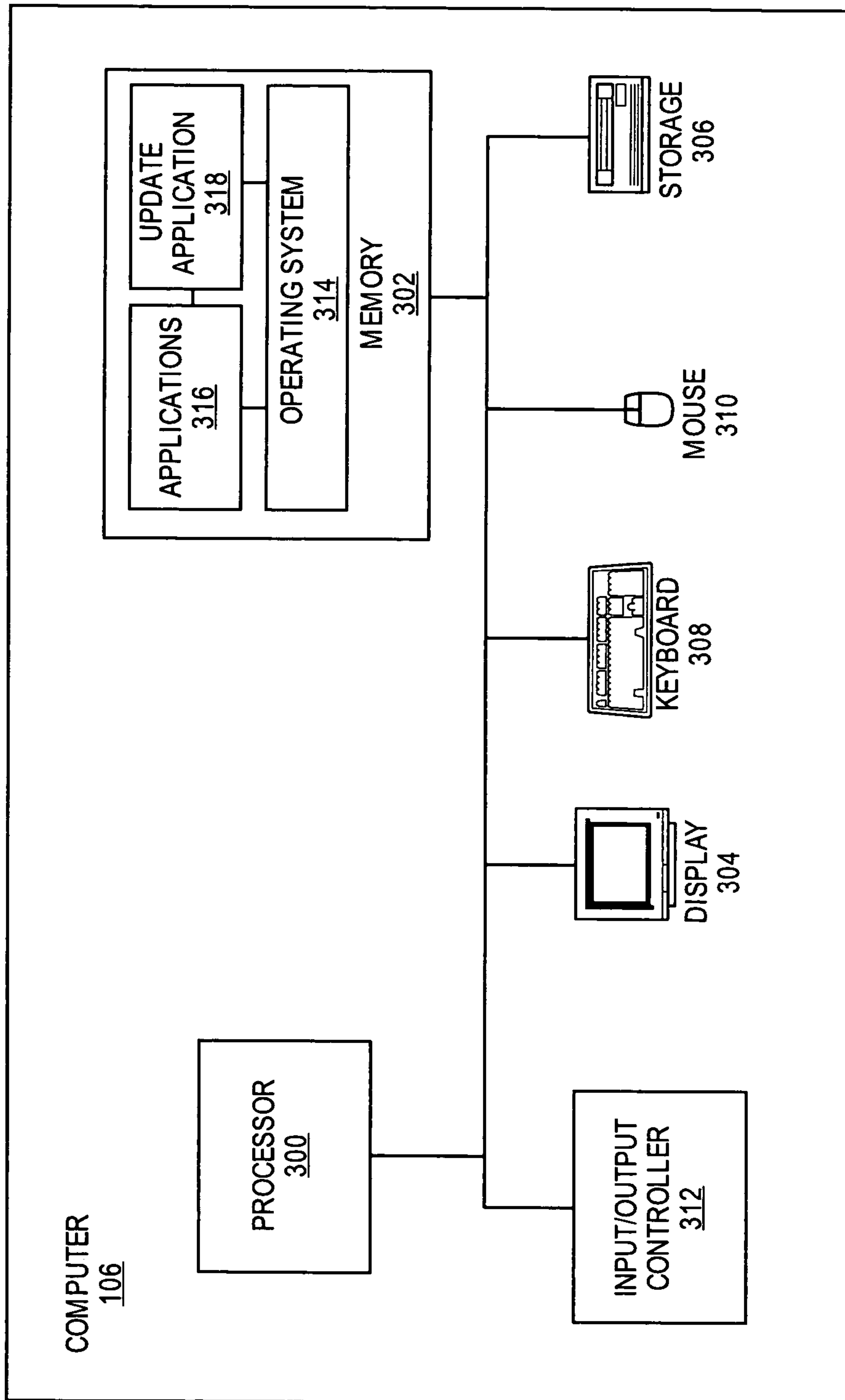


FIG. 3

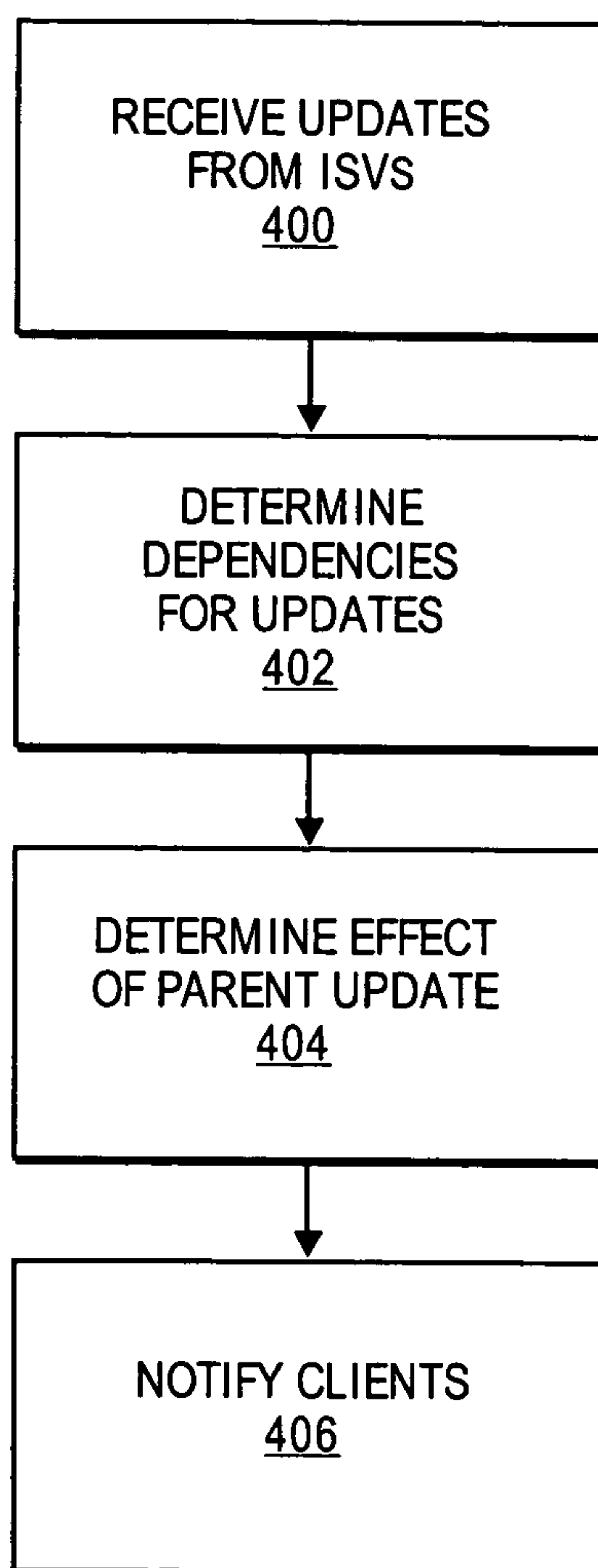
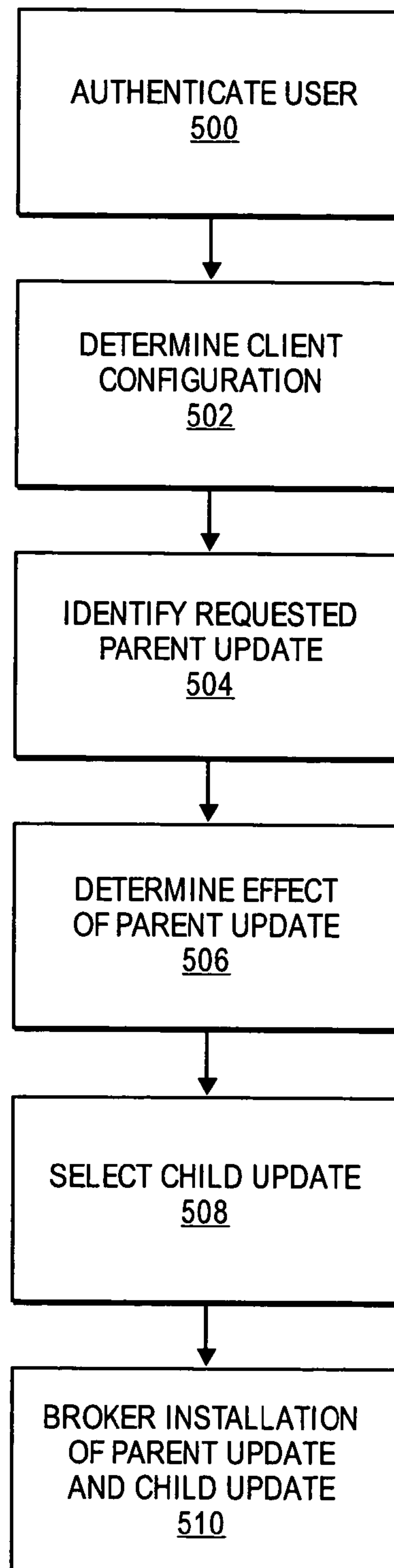


FIG. 4

**FIG. 5**

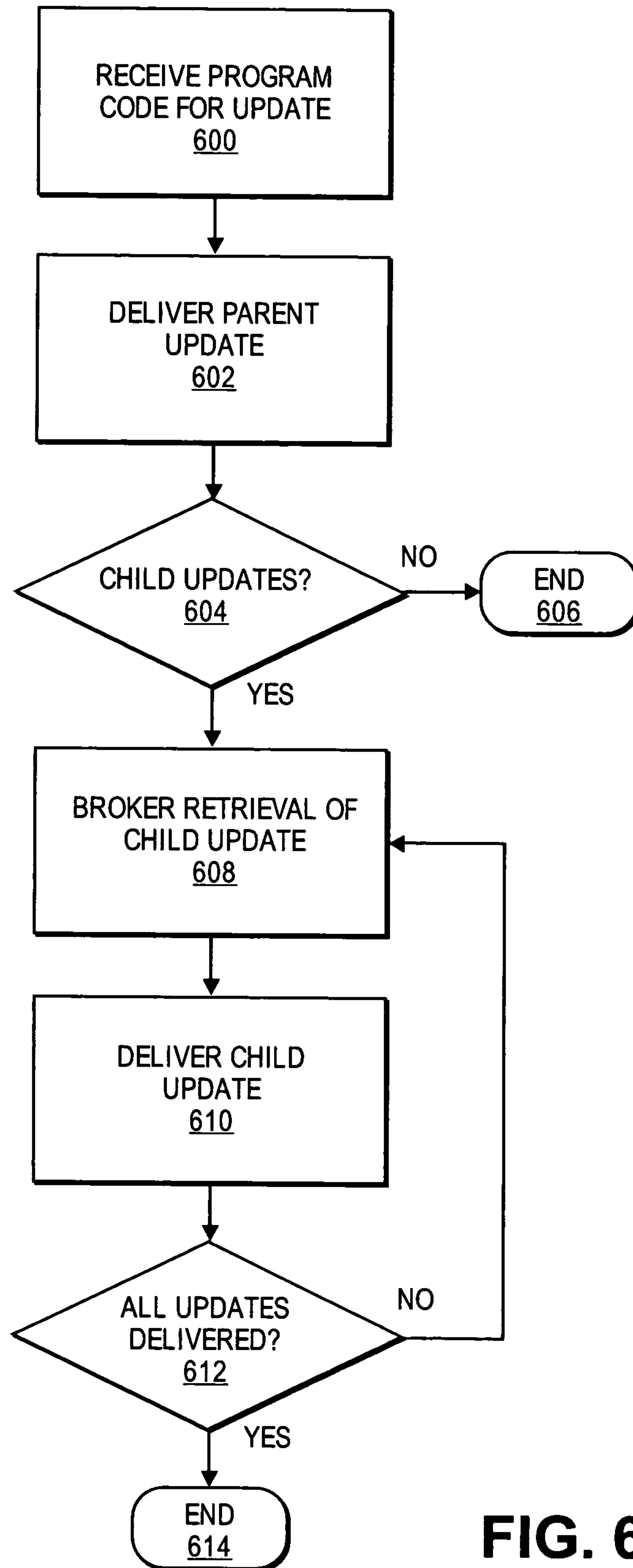


FIG. 6

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SHARING SOFTWARE CERTIFICATION AND PROCESS METADATA

FIELD OF THE INVENTION

The present invention relates to managing software packages.

INTRODUCTION

Users and enterprises today rely upon complex information technologies. These information technologies usually require computers, servers, and other systems that contain various installed software, such as an operating system, utilities, applications, and device drivers, code libraries, etc. Many of the software products will come from different software vendors, such as independent software vendors. A software vendor can be any entity that distributes software products, even if another entity wrote the software program code.

In order to help manage software, administrators or users typically use a package management system. A package management system is a collection of tools to automate the process of installing, upgrading, configuring, and removing software packages from a computer. The term is most commonly used with regards to operating systems, particularly Linux-like operating systems, since these systems often may include a large number of discrete packages on a typical installation.

In Linux systems, software is typically distributed in packages, usually encapsulated into a single file. Packages often include metadata that is intrinsic to the software, such as the full name of the software, version, vendor of the software, checksum information, and a list of other packages, known as dependencies that are required for the software to execute properly.

Unfortunately, the interactions between different pieces of software are complex and difficult to manage. For example, the task of maintaining software products can be overwhelming. In many instances, software products can be interdependent, and thus, updates to one software product, such as the operating system, may require updates to several other software products. Typically, if a software vendor's software depends on another software product, one or more of the software vendors may certify their software based on a particular version or level of updates. Nonetheless, in view of the number of software products and software vendors that may be involved, users and enterprises have found it daunting to monitor all of the available distribution channels, journals, Internet forums, and the like, to determine how to install and manage their software.

Accordingly, it would be desirable to provide methods and systems that assist in managing and updating software.

SUMMARY

In accordance with one embodiment of the invention, a method of packaging software is provided. Supplemental qualitative information about the software is gathered and supplemental metadata associated with the gathered information is determined. The supplemental metadata is then packaged with the software in a set of files.

In accordance with another embodiment of the invention, a method of certifying a package of software is provided. The package of software is received and supplemental qualitative information about the software is identified from metadata in the package. The package of software is then certified based on the supplemental qualitative information.

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In accordance with yet another embodiment of the invention, a method of managing software based on a policy is provided. A package of software is received and supplemental qualitative information about the software is determined based on metadata that supplements the package. The software is then managed based on a policy that is determined from a combination of characteristics indicated in the supplemental qualitative information.

Additional embodiments of the invention will be set forth in part in the description which follows, and in part will be obvious from the description, or may be learned by practice of the invention. It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description, serve to explain the principles of the invention.

FIG. 1 shows an architecture of one embodiment of a system for certifying and updating software in accordance with the principles of the present invention;

FIG. 2 shows an exemplary architecture for an update service that is consistent with the principles of the present invention;

FIG. 3 shows one example of the hardware and software architecture of a computer;

FIG. 4 illustrates a process for collecting updates for software and notifying users of the update service in accordance with the principles of the present invention;

FIG. 5 illustrates a process for preparing a set of updates in accordance with the principles of the present invention; and

FIG. 6 illustrates a process for installing a set of updates in accordance with the principles of the present invention.

DESCRIPTION OF THE EMBODIMENTS

Embodiments of the present invention provide a management service for maintaining software of one or more users, or an enterprise. The management of software may comprise a variety of transactions including installation, upgrades, uninstallation, certification, and the like. On behalf of users or enterprises, the management service collects supplemental metadata about the certification and updates of software as well as processes related to the development and testing of the software. Supplemental metadata relates to any information that qualitatively describes the software outside of its basic operations. Examples of the supplemental metadata collected include information regarding: the organizations that tested or certified the software; the specific standards by which the software was tested; the performance of the software; the functions of the software; the processes used to develop or test the software; and legal requirements which the software is compliant. Each piece of supplemental metadata may be individually authenticated (e.g., using a digital signature) to ensure its accuracy. In addition, pieces of supplemental metadata can be combined with other supplemental metadata. Accordingly, a user or system administrator may then use various policies to determine which updates to install based on the supplemental metadata in addition to the typical intrinsic metadata, such as dependency information.

The supplemental metadata may be provided to the users or enterprises in various ways. For example, the supplemental metadata may be incorporated into a software package or may be provided in a separate file.

The management service may broker the distribution of supplemental metadata in various ways. For example, the management service may retrieve supplemental metadata from respective software vendor sites and provide it to the users or enterprises. As another example, the management service may proxy a connection between a software vendor's site and the users or enterprises, or may provide a link to the software vendor's sites that can be opened by the users or enterprises. Furthermore, as part of its brokerage function, the management service may arrange for payment (if required) for any of the supplemental metadata.

Reference will now be made in detail to the embodiments of the invention, which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

FIG. 1 shows an embodiment of a system 100 for managing software in accordance with the principles of the present invention. As shown, system 100 may include a set of software vendors (labeled as ISV) 102 and an management service 104 for managing software. In some embodiments, system 100 may operate in several modes. For example, in one mode ("hosted mode"), management service 104 is directly coupled to a single client, such as a user's computer 106. Although FIG. 1 depicts a single computer 106, embodiments of the present invention may accommodate any number of clients, users, and computers 106.

In another mode ("satellite mode"), management service 104 provides information to an enterprise 108 that supports a number of clients, such as a plurality of computers 106. Enterprise 108 may comprise any number of computers, networks, and systems. For example, as shown in FIG. 1, enterprise 108 may include a satellite server 110 and a network 112 that couples together a plurality of computers 106. Of course, enterprise 108 may include other components, such as a firewall, or other network elements and may be configured according to other types of known architectures to support computers 106.

The components of system 100 may communicate with each other in a variety of ways. For example, software vendors 102 and management service 104 may be coupled through the Internet, or other network management service 104 may also be coupled to computer 106 and enterprise 108 through the Internet, or other network. In particular, the various components of system 100 support various protocols used across the Internet, such as TCP/IP, FTP, HTTP, HTML, etc. In addition, files may be identified in system 100 using universal resource locators (URLs) as known by those skilled in the art.

Alternatively, management service 104 may communicate with the other components indirectly. For example, management service 104 may provide to and receive its information from enterprise 108 and satellite server 110 in the form of a computer readable medium, such as a compact disc.

The components of system 100 will now be further described. Software vendors 102 may comprise one or more servers that are coupled to management service 104. In some embodiments, software vendors 102 are configured to provide software update information, software products, information files, program code or scripts for installation, and the like. The software update information may include program code for applications, binary files, text files, and the like, for updating software products installed on computers 106. Software vendors 102 may also provide supplemental metadata, such as information related to product support, technical service, and information describing the processes used to test or develop the software. Software vendors 102 may further con-

trol distribution and payment for their software updates and supplemental metadata using known techniques, such as credit cards and conventional encryption techniques.

Software vendors 102 may be implemented using one or more computers (not shown) that are known in the art. For example, software vendors 102 may be represented as a website on the Internet.

Management service 104 provides information and supplemental metadata related to certifying and updating the software installed on computers 106 or enterprise 108. In some embodiments, management service 104 is implemented as a website on the Internet. Accordingly, management service 104 may include any number of conventional servers (not shown). Such servers may be implemented with an Intel-based processor that executes an operating system, such as the Linux operating system. Furthermore, the servers of management service 104 may support the TCP/IP communication for connecting to the other components of system 100, such as software vendors 102, over the Internet.

Of course, one skilled in the art will recognize that management service 104 may include any amount of sufficient hardware to support a relatively large number of multiple computers 106 and enterprises 108 simultaneously for requests for data and other operations. One example of an architecture for management service 104 is shown in FIG. 2.

Computers 106 may be of any known type of computer or computer system. Computer 106 may have installed a number of software products including an operating system, applications, drivers, utilities and the like. In some embodiments, computers 106 may be any device having the Linux operating system installed. Computers 106 are also described with reference to FIG. 3.

Enterprise 108 represents any organization that supports one or more users, for example, with satellite server 110 and network 112. For example, enterprise 108 may be a customer of management service 104.

As shown, enterprise 108 may include satellite server 110 in order to optimize the software installed on computers 106 within a local network of enterprise 108, such as network 112. Satellite server 110 may be any conventional computer or server system known to those skilled in the art. For example, satellite server 110 may be a server that operates based on the Linux operating system and an embedded database (not shown), such as an Oracle database.

As noted above, satellite server 110 can be connected to management service 104, for example, over the Internet. Alternatively, satellite server 110 can run disconnected from management service 104 and instead receive information in the form of a computer readable medium.

In addition, enterprise 108 may include other servers to assist the operations of satellite server 110. For example, enterprise 108 may include proxy servers that run either in hosted mode or satellite mode, which function as an intelligent cache that is attached to enterprise 108. Of course, other architectures for enterprise 108 are consistent with the principles of the present invention.

Network 112 provides a communication infrastructure for computers 106 that belong to enterprise 108. Network 112 may be implemented based on known topologies and components. For example, network 112 may be implemented based on one or more local area networks, such as an Ethernet network, a wide area network, the Internet, or the like.

FIG. 2 shows an exemplary architecture for management service 104 that is consistent with the principles of the present invention. In accordance with the present invention, the management service 104 includes a number of executable components and database structures useful for certifying and

updating software installed on computers **106**. As shown, management service **104** may include a software vendor interface module **200**, a client interface module **202**, an inventory module **204**, an update module **206**, a management module **208**, and a provisioning module **210**. These components may be implemented based on known components of hardware and software. For example, these components may be implemented as applications running on one or more conventional servers. In some embodiments, the servers of management service **104** run applications and the Linux operating system. In addition, management service **104** may include one or more embedded databases. For example, as shown, management service **104** may include a dependency database **212**, a client inventory database **214**, an update database **216**, and a client account/profile database **218**. These databases may be implemented based on any known schema, for example, as a relational or object oriented database. Of course, one skilled in the art will recognize that the supplemental metadata collected by management service **104** may be stored in one or more of the embedded databases described above or in other databases coupled to management service **104**. The functions of these exemplary components of management service **104** will now be further described.

Software vendor interface module **200** manages communications between management service **104** and software vendors **102**. For example, software vendor interface module **200** may be configured to periodically poll software vendors **102** on a regular basis to request update information and supplemental metadata for the respective software products of the software vendors **102**. As another example, software vendor interface module **200** may be configured to passively monitor for update information and supplemental metadata from software vendors **102**.

The information from software vendors **102** regarding updates and supplemental metadata may include a wide variety of data and may be in any format. For example, information from software vendors **102** that may be considered useful includes version information, file formats, configuration information, and network location, such as a URL on the Internet. Alternatively, software vendor interface module **200** may be configured to obtain software update information and supplemental metadata from software vendors **102** by searching the Internet to identify who of software vendors **102** are providing updates and supplemental metadata for their software products. Software vendor interface module **200** may then download the updates and supplemental metadata from the sites for software vendors **102**, or store one or more network locations (e.g., URL) where the download for an update or supplemental metadata can be obtained.

Client interface module **202** manages communications by management service **104** in either hosted mode or satellite mode with update module **206**, management module **208**, or provisioning module **210**. Those skilled in the art will understand client interface module **202** may interact with computer **106** in hosted mode or satellite server **110** in parallel and in ways that are specific to a particular user or enterprise **108**.

For example, client interface module **202** may provide one or more pages that authenticate the identity of computer **106** or enterprise **108**, such as a user ID, password, digital certificates, and the like. This information may be manually entered by a user at computer **106** or satellite server **110**, or may automatically provided once a connection is established. In addition, client interface module **202** may be configured to collect other information, such as contact information, a mailing address, an email address, and payment information. Of course, client interface module **202** may also provide instructions and a process for registering a new user or new enter-

prise. As another example, client interface module **202** may also provide information indicating the availability of updates for various software products or the current certification status of software products.

Inventory module **204** analyzes computers **106** or enterprise **108** to determine the installed software products and maintain an inventory of this software. In some embodiments, inventory module **204** is also configured to maintain supplemental metadata about the installed software products as part of its records. As noted, these software products may be from any of software vendors **102**. In some embodiments, inventory module **204** may maintain its information in client inventory database **214**. For example, the inventory module **204** may operate with client interface module **202** to periodically request or collect a list of software installed in computers **106** or enterprise **108**.

Update module **206** operates in conjunction with update database **216** and maintains and provides information identifying software products, information about the software updates that are available from software vendors **102** for their software products, information for identifying software products installed on computers **106**, and information for uniquely distinguishing the versions and names of installed software products. In some embodiments, update database **216** may also maintain and provide supplemental metadata about updates, such as metadata indicating standards used to test the update, and various legal requirements that the update was intended to comply with. In addition, update module **206** may include conventional software and hardware that provide a graphical user interface through client interface module **202** for accessing the above-indicated supplemental metadata, a notification service regarding the software updates, a dependency checking feature, and an auto-update feature.

Management module **208** assists update module **206** and allows for role-based administration for policies and permissions, and scheduled actions. For example, management module **208** may operate with satellite server **110** to provide a custom channel of updates and supplemental metadata for enterprise **108**, local package caching for enterprise **108**, and off-network capabilities.

In addition, management module **208** may provide a graphical user interface or other form of front-end listing the dependencies of updates in packages, request and install packages if recommended or suggested by newly installed packages, automatically install dependencies, perform other operations on the system's packages to allow the installation of the packages, and provide an interface for displaying and retrieving the supplemental metadata for each component in the package.

Provisioning module **210** works in conjunction with update module **206** and management module **210** to allow for provisioning of software to computers **106**, configuration management of computers **106**. For example, provisioning module **210** may assist computers **106** or enterprise **108** with uninstallation, and multi-state rollback or recovery of updates. In addition, provisioning module **210** may assist in scheduling remote actions, such as the installation of the updates, and kick starting configuration tools. For example, provisioning module **210** may be configured to provision operating systems and one or more applications on to computer **106**.

Dependency database **212** maintains the intrinsic metadata information related to the dependencies between software products. For example, dependency database **212** may include information that indicates an application is dependent

upon a particular version of a Linux operating system kernel. Dependency database 212 may use any known schema to structure this information.

Client inventory database 214 maintains information identifying which software products are installed on computers 106. For example, client inventory database 214 may include information indicating one or more operating systems and applications installed on computers 106. This information may indicate data, such as a version number or release number. In addition, client inventory database 214 may include various supplemental metadata, such as who installed the software on computers 106 and reasons (such as a bug fix or new legal requirement) for installing a particular update on computers 106.

Update database 216 maintains the information related to obtaining updates and supplemental metadata for the various software products from software vendors 102. For example, update database 216 may store information describing an installation process for installing a software update. This information may include configurations supported, a file format, or other data useful to performing the installation of the software update. In some embodiments, update database 216 may include the program code for installing the updates.

For example, update database 216 may include a schema or data structure that indicates a company name for each of software vendors 102, a software product name, a product type, information to identify the software product on computer 106, a file name or string used to identify products from software vendors 102, version information, and dates or a timestamp. The product type can be an operating system component, such as a device driver, or an operating system file, or an application.

In other embodiments, however, update database 216 does not itself store the software updates, but rather stores information, such as URLs, that allow management service 104 to broker access to the software update. In turn, computers 106 or satellite server 110 may access the software updates through management service 104, or directly from software vendors 102.

Client account/profile database 218 maintains the information related to authenticating a user or enterprise and determining their respective rights. For example, a user or enterprise may select various categories or channels of content in which they are interested in receiving updates. A channel may provide information related to one or more variations of an operating system, specific applications from software vendors 102, and configuration files. In addition, a user or enterprise may subscribe to multiple channels of content from management service 104. Database 218 may further include information that indicates the permissions and delivery of the information in a channel.

Other information that may be included in client account/profile database 218 may comprise groups defined in an enterprise, system and individual permissions, activation keys, registration information, and payment information (such as credit card information). Furthermore, client account/profile database 218 may include other information related to manner in which management service 104 provides information. This information may relate to periodicity of notifications, email addresses, format of the information, and the like. Furthermore, client account/profile database 218 may be used by management service 104 to log the activities and transactions of its users. Activities that are typically logged are well known to those skilled in the art.

FIG. 3 shows one example of the hardware and software architecture of computer 106. As shown, computer 106 may be a conventional device that includes a processor 300, a

memory 302, and other known features, such as a display 304, a storage device 306, such as a hard disk, a keyboard 308, a mouse 310, and an input/output controller 312, such as a network interface.

Computer 106 further may have software products installed in memory 302 including an operating system 314, applications 316, and an update application 318. In some embodiments, these software products are among those whose updates are brokered by management service 104.

Operating system (“OS”) 314 is an integrated collection of routines that service the sequencing and processing of programs and applications run by computer 106. OS 314 may provide many services for computer 106, such as resource allocation, scheduling, input/output control, and data management. OS 314 may be predominantly software, but may also comprise partial or complete hardware implementations and firmware. Well-known examples of operating systems that are consistent with the principles of the present invention include Linux, Mac OS by Apple Computer, Open VMS, AIX by IBM, Java and Sun Solaris by Sun Microsystems, Windows by Microsoft Corporation, Microsoft Windows CE, Windows NT, Windows 2000, and Windows XP.

In some embodiments, updates to the components of OS 314 may be brokered by update server 104. For example, OS 314 may be a Linux operating system, and thus, may comprise a kernel, kernel modules, loadable kernel modules, system shared libraries, and the like. OS 314 may also include or be coupled to system management programs, user processes (for running applications 316), user utility programs, and compilers. Any of these components may be subject to an update that is generated by one of software vendors 102 and brokered by management service 104. For example, updates to kernel modules from software vendors 102 may be brokered by management service 104.

Applications 316 may be “loaded” (i.e., transferred from storage 306 into memory 302) for execution by computer 106. For example, applications 316 may be applications, such as a browser, a firewall, a word processor, and the like that are provided from software vendors 102. Other examples for applications 316 are well known to those skilled in the art.

Update application 318 maintains an inventory of the software installed on computer 106 and archives one or more states of computer 106. In some embodiments, update application 318 archives the state of computer 106 prior to each update installation. In addition, update application 318 may be configured to transmit the software inventory of computer 106 to satellite server 110 or management service 104. In turn, the software inventory of computer 106 may be stored as part of the information in client inventory database 214.

For example, update application 318 may be configured to periodically connect to satellite server 110 or management service 108 to access client inventory database 214. Update application 318 may then download or request a portion of database 214 that is applicable to computer 106.

Various processes for certifying and updating software will now be described with reference to FIGS. 4-6. In general, a user or enterprise (such as enterprise 108) may subscribe to one or more channels provided by management service 104. management service 104 collects and maintains information and supplemental metadata related to software installed on computers 106 of the user or enterprise 108. management service 104 may then track dependencies between software products, such as the dependency between operating system components or between an operating system and an application, and monitor the progress of these updates. management service 104 may notify its users when the progress of updates reaches various stages, such as when updates become avail-

able or when updates are not yet available. In addition, management service **104** may provide the supplemental metadata for various updates simultaneously or in a separate notification. Finally, management service **104** may broker the delivery or installation of the updates in a manner that optimizes their effect. For example, management service **104** may broker several updates that are related or dependent upon each other. The brokering of updates may range, for example, from providing the program code for the update to providing one or more links to the update. The delivery or installation of the updates and supplemental metadata may be implemented under the control of management service **104**, or under the control of the user or enterprise **108**.

FIG. 4 illustrates a process for collecting updates and supplemental metadata for software and notifying users of the management service in accordance with the principles of the present invention. In stage **400**, management service **104** receives update information and supplemental metadata from software vendors **102**. For example, as new software updates or supplemental metadata become available from software vendors **102**, either update module **206** of management service **104** or software vendors **102** they access update database **216**. In some embodiments, software vendors **102** may provide data that includes one or more fields for: new update information, or changes to existing update information; information describing the update; a URL for the information on the software update; version information; dependency information, such as other software products affected by the update; the type of update; known incompatibilities or errors; a URL for locating prior versions of the software product to be updated; and a URL for the software update itself. In addition, management service **104** may collect the installation procedures, such as an installation script for the updates.

As noted, software updates may be collected into update database **216** in various ways. For example, software vendor interface module **200** may periodically search the Internet to identify any software vendors **102** that are providing updates and supplemental metadata for various software products. Upon finding a software update, software vendor interface module **200** may work in conjunction with update module **206** to download the software updates and supplemental metadata to updates database **216**.

While gathering the information for the updates and supplemental metadata, update module **206** may determine a file format of the software update and the installation process specified according to the file format of the software update based on information provided by software vendors **102**. In some embodiments, software vendors **102** may provide supplemental metadata about their software products and software updates, such as name, file format, and so forth, based on a contractual relationship with management service **104**, enterprise **108**, or users at computers **106**.

Update module **206** may make entries into update database **216** to include the URL or network location of servers for software vendors **102** that can provide the update and supplemental metadata, to store the software update or supplemental metadata itself, the file format of the software update and supplemental metadata, and the installation process. Also, the supplemental metadata may include a URL to a description about the software update, such as the problems that the update fixes or features added may be stored in update database **216**. Of course, one skilled in the art will recognize that either software vendors **102** or management service **104** may specify the entries that are made into update database **216**. Processing may then flow to stage **402**.

In stage **402**, update module **206** determines dependencies between the software updates. In some embodiments, update

module **206** may evaluate dependencies between updates based on a parent/child model. A parent software update may be any update that influences or requires another update known as the child software update. A parent update may give rise to any number of child updates or even other parent updates. A dependency may span across one or more of software vendors **102**.

For example, dependencies between various updates may be explicitly specified in the information provided from software vendors **102**. In addition, update module **206** may determine dependencies between software updates based on other techniques. For example, updates to an operating system kernel may give rise to the need for child updates to other components of the operating system, such as the kernel modules, device drivers, and the like. As another example, one or more updates to an operating system kernel may give rise to child updates to one or more applications that were certified for a previous version of the kernel. These are just a few examples of how update module **206** may determine the dependencies and the nature of these dependencies between software updates. Processing may then flow to stage **404**.

In stage **404**, management service **104** determines if there any effects for each parent update. For example, update module **206** may determine the effect of a particular parent update based on the dependency information provided from software vendors **102**. In addition, update module **206** may also consider other criteria in determining the effect of parent updates. The nature of the effect created by a parent update may encompass a wide range of situations. For example, a parent update to an operating system kernel may cause errors in the operation of the operating system components. Thus, the effect of that parent update would be those errors and one or more child updates may be selected to correct the errors. Of course, one skilled in the art will recognize that other types of effects may be determined, such as effects related to adding a new feature to a software product. Processing may then flow to stage **406**.

In stage **406**, management service **104** may send information and supplemental metadata to the client related to the set of updates. For example, client interface module **202** may provide the information and supplemental metadata to computers **106** or enterprise **108** in the form of one or more web pages. The information provided may include information about the parent update, any effects of the parent update, information about one or more of the child updates, and the like, as well as the supplemental metadata.

Returning to FIG. 2, client interface module **202** may also be configured to send information and supplemental metadata based on the information in client account/profile database **218**. As noted above, client account/profile database **218** maintains a profile for each user of management service **104**. This information may contain information about which software products a user or enterprise **108** has shown an interest, for example by requesting notification about software updates for specific products, or about new software products. Accordingly, client interface module **202** may deliver notifications about updates and supplemental metadata available for these products to the user, for example by email, or other electronic communications mechanisms. The information about an update and supplemental metadata from client interface module **202** may include, for example, a URL or link to access the software update files.

In another example, client interface module **202** may notify the users of management service **104** at various times to indicate the progress of availability of software updates and supplemental metadata. In particular, for a given parent update, one or more child updates may or may not yet be

available from software vendors **102**. As these updates become available, client interface module **202** may then notify the users of management service **104** about the status of these updates. As another example, when a particular update has been tested by a reputable organization or gained certification to a standard of interest, this supplemental metadata may be provided in a notification from management service **104**.

As another feature, client interface module **202** may work in conjunction with update module **206**, management module **208**, and provisioning module **210** to check for conditions that must be satisfied for the software update or software product to be installed on one of computers **106** or within enterprise **108**. For example, these conditions may be based on the channels to which enterprise **108** has subscribed or based on the versions of the software product to which an update is applicable.

FIG. **5** illustrates a process for preparing a set of updates in accordance with the principles of the present invention. In stage **500**, management service **104** may authenticate the request for the set of updates and supplemental metadata. A user at computer **106** or from enterprise **108** may manually initiate this process, or it may occur automatically, for example at preset periods, such as once every few hours, daily, weekly, or once a month. Alternatively, this process may be initiated by management service **104** at various intervals, or in response to particular events.

Management service **104** may then proceed with the authentication in various ways. For example, management service **104** may determine whether the software updates and supplemental metadata are free or not and check client account/profile database **218** for payment information, if applicable. management service **104** may then arrange for payment, for example, based on the subscription attributed to the user, or connect the user to a software vendor **102**. Processing may then flow to stage **502**.

In stage **502**, management service **104** determines the configuration of software products that are installed on the client. In particular, inventory module **204** analyzes computers **106** or enterprise **108** to determine the installed software products. As noted, these software products will typically be from one or more of software vendors **102**.

In some embodiments, inventory module **204** may perform its analysis based on the information in client inventory database **214**. Alternatively, inventory module **204** may submit a request to computers **106** or enterprise **108** for the list of installed software products. For example, update application **318** may be invoked at various times to analyze the software installed on computer **106**. The information may then be provided to management service **104**. Processing then flows to stage **504**.

In stage **504**, management service **104** may identify one or more of the software updates as a parent update. For example, update module **206** may consider the update that was requested as the parent update. Update module **206** may also analyze the configuration of the installed software products and determine that one or more parent updates are required. For example, update module **206** may query update database **216** to determine if there are updates available for the installed software products. Update module **206** may then query dependency data **212** and determine the respective dependencies between any of the available updates and retrieve any corresponding supplemental metadata. Based on these dependencies, update module **206** may then determine that one or more parent updates should be selected and determines the supplemental metadata that should accompany this set of updates. Processing then flows to stage **506**.

In stage **506**, management service **104** may determine any effects of the parent update on the software installed. For example, update module **206** or management module **208** may query update database **216** to determine the effects of a parent update.

In stage **508**, management service **104** may select one or more child updates for the software. For example, based on the identified parent updates, update module **206** may query dependency database **212** and select various child updates that arise from the parent updates. Update module **206** may select child updates that compensate for any effects, such as an error or new feature, of the parent update based on the information in dependency database **212**. Alternatively, management service **104** may allow a user at computer **106** or within enterprise **108** to select the child updates. For example, client interface module **202** may provide the list of possible software updates to the user. The supplemental metadata may include the name of each software product and comments indicating the status of an installed software product. The comments in the supplemental metadata may describe the nature of the software update, such as whether the update corrects a known problem or provides new features.

In some embodiments, client interface module **202** allows for the retrieval of additional supplemental metadata that is requested about a software product. This information may be stored, for example, in update database **216**, or may be obtained from software vendors **102**, for example by using URLs. A user may then select one or more of the updates that are to be provided by management service **104**. Processing may then flow to stage **510**.

In addition, management service **104** may enforce one or more policies related to software updates that depend upon the supplemental metadata. For example, various updates may be selected due to compliance with a legal standard indicated in the supplemental metadata. As another example, only those updates that have been tested by a particular process or organization may be desired. Thus, a user or system administrator may use various policies to manage software using information that is beyond the typical intrinsic information, such as dependency information.

In stage **510**, management service **104** brokers the delivery or installation of the parent update and any child updates and the supplemental metadata. For example, client interface module **202** may request that the user confirm or cancel the installation of the set of updates. If confirmed, update module **206** may then arrange for the download of the software updates, along with installation information, such as installation programs, files, and the supplemental metadata, to computers **106** or satellite server **110**.

Update module **206** may broker the delivery or installation of the parent update and any child updates and supplemental metadata in a variety of ways. For example, update module **206** may directly download the update code or installation files for either the parent update or child update from update database **216**. Alternatively, update module **206** may provide a link or redirect a connection to obtain the update code, installation files, and supplemental metadata directly from software vendors **102**, using the URL data stored in update database **216**. Any combination of these techniques may be used for the updates and supplemental metadata. In addition, update module **206** may broker the installation of the parent update and any child update in various sequences. For example, update module **206** may broker the installation of the updates such that the parent update and child updates are installed simultaneously or sequentially. Installation of the parent update and child update may be in any order, for

example, based on user preferences. Furthermore, the installation of the parent update and child update may occur at separate times.

FIG. 6 illustrates a process for installing a set of updates in accordance with the principles of the present invention. In stage 600, computer 106 receives program code for the parent update and its supplemental metadata. The program code may be a package that includes one or more installation programs, files, the supplemental metadata, and the like. Alternatively, computer 106 may receive the update code for the update. As noted above, computers 106 may receive the program code directly from management service 104 or indirectly via satellite server 110. The program code may be received over a network, such as the Internet, or in the form of a computer readable medium.

In stage 602, computer 106 (or satellite server 110) proceeds with taking delivery of the parent update. For example, computer 106 may invoke update application 318 upon receiving the program code or upon execution of at least part of the program code. In response, update application 318 may archive the current state of computer 106 and then record changes made to computer 106 as a result of the installation of the software update. Update application 318 may then proceed with taking delivery of the parent update, for example, by performing any decompression, installation, reading the supplemental metadata, or setup applications necessary to install the software update.

In addition, in some embodiments, update application 318 records any changes made to computer 106, including changes to various configuration files, additions or deletions of files, and additions or deletions of directories and reports this information back to management service 104. Processing may then flow to stage 604.

In stage 604, computer 106 (or satellite server 110) may determine if there are any child updates that are related to the parent update and any corresponding metadata. For example, computer 106 (or satellite server 110) may receive information, such as a URL, that indicates a child update that is related to the parent update. As another example, computer 106 (or satellite server 110) may receive one or more messages from management service 104 that indicates whether a child update is related to the parent update. Such messages and their format are known to those skilled in the art. The information from management service 104 may also include supplemental metadata from software vendors 102, such as information explaining the nature and purpose of the child update and its dependency information. If computer (or satellite server 110) does not find a child update or finds information that indicates the lack of a child update, then processing may flow to stage 606. In stage 606, computer 106 (satellite server 110) may proceed with completing the installation of the parent update and then processing may end. One skilled in the art will recognize that computer 106 (or satellite server 110) may complete their processing in a variety of ways, such as sending a message to management service 104 or displaying a message to the user that installation of updates is complete.

If computer 106 (or satellite server 110) determines a child update is pending, then processing may flow to stage 608. In stage 608, computer 106 (or satellite server 110) receives information brokered from management service 104 that indicates a child update. As noted above, the delivery or installation of the child update may be brokered with the parent update because the child update may compensate for an effect of the parent update on the software installed on computers 106. The information may include additional program code for installing the child update, such as the update

code for the update, installation application, and files. Alternatively, the information may include a link, such as a URL. The information brokered from management service 104 may also relate to other aspects of installing the child updates, such as payment, and authentication. Processing may then flow to stage 610.

In stage 610, computer 106 (or satellite server 110) retrieves the child update based on the information brokered from management service 104. For example, computer 106 may download the program code for taking delivery of or installing the child update from update database 216. Alternatively, computer 106 may open a connection to the URL at software vendors 102 provided from management service 104 and download the program code for installing the child update from this location. Processing then flows to stage 612.

In stage 612, computer 106 (or satellite server 110) determines whether any further updates are pending. One skilled in the art will recognize that this stage of processing may be performed in conjunction with or subsequent to the installation of any of the parent or child updates retrieved in the previous stages. Computer 106 (or satellite 110) may determine if further updates are pending based on the information brokered from management service 104. For example, management service 104 may provide one or more messages or links that indicate additional updates are related or dependent on a parent update. As another example, management service 104 may provide a message or link that indicates all updates have been delivered to computer 106 (or satellite server 110). If all updates have not been delivered, then processing may repeat, for example, at stage 608. If all updates have been delivered, then processing may proceed to stage 614.

In stage 614, computer 106 (or satellite server 110) may complete their processing. For example, computer 106 (or satellite server 110) may complete taking delivery of the parent updates and any child updates. Computer 106 (or satellite server 110) may then proceed with installing the parent and/or child updates. Of course, the installation of the parent and child updates may proceed at various times. For example, computer 106 may perform decompression, installation, and execute setup applications necessary to install the parent or child software updates at predetermined times automatically, or upon command by a user or administrator. Of course, one skilled in the art will recognize that this process may be individually repeated for each update, or simultaneously as the updates are delivered.

In addition, when all of the software updates have been installed, computer 106 or satellite server 110 may log out from its session with management service 104. In some embodiments, client interface module 202 may then request any necessary payment information. Alternatively, no payment may need to be directly made, as the cost of management service 104 may be included in the cost of a subscription to one of the channels or charged separately by software vendors 102. In some embodiments, management service 104 may mediate connections through the Internet for making payment to software vendors 102 as part of its brokering of the updates.

Other embodiments of the invention will be apparent to those skilled in the art from consideration of the specification and practice of the invention disclosed herein. For example, embodiments of management service 104 may also support brokering the uninstallation of one or more updates. In this situation, management service 104 may thus assist computer 106 or satellite server 110 in determining which updates should be uninstalled and/or provide other updates that assist in recovering from the uninstallation.

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A user at computer **106** or within enterprise **108** may decide to undo or uninstall one or more of the updates, for example, due to dissatisfaction with a software product or its new features. Accordingly, management service **104** may be configured with an uninstall feature, for example via provisioning module **210**, that backs-out any previous installation it brokered. This feature may rely on archived information stored in client inventory database **214**. One skilled in the art will recognize that uninstallation will involve conventional techniques, such as deleting files and directories that were added, restoring files and directories that were deleted, and restoring files that were otherwise changed. Similar to the installation process, an uninstallation feature of management service may be performed based on uninstalling parent updates and their child updates. The uninstallation may also be performed simultaneously or in series at various times. Furthermore, if any payments were made for the software updates, management service **104** may broker the refund or crediting of these costs.

Nonetheless, it is intended that the specification and examples be considered as exemplary only, with a true scope and spirit of the invention being indicated by the following claims.

What is claimed is:

1. A method comprising:

receiving, by a processing device at a server system, update information and supplemental metadata associated with the update information for a plurality of software programs comprising a first software program provided by a first vendor among a plurality of vendors and a second software program provided by a second vendor among the plurality of vendors, wherein the first vendor is distinct from the second vendor, wherein the first software program comprises an operating system component, wherein the second software program comprises an application, wherein the application complements operation of the operating system component, and wherein the update information comprises dependency information regarding the application being dependent on updates to the operating system component;

determining, by the server system, a dependency of the application on a parent software update to the operating system component in view of the dependency information;

receiving, by the server system, a request from a client computer for updates to the operating system component at the client computer and the supplemental metadata, wherein the parent software update is responsive to fulfilling the request for updates to the operating system component at the client computer;

determining, by the server system, an effect of the parent software update on the application at the client computer in view of the dependency information;

selecting, by the server system, a child software update that compensates the determined effect of the parent software update on the application at the client computer, wherein the second vendor provides the child software update and the first vendor provides the parent software update;

selecting, by the server system, a second child software update that compensates the determined effect of the parent software update on the application at the client computer, wherein a third vendor among the plurality of vendors provides the second child software update, wherein the third vendor is distinct from the first vendor and the second vendor, wherein the third vendor provides a third software program from the update informa-

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tion for the plurality of software programs, wherein the third software program comprises a second application, wherein the second application complements operation of the operating system component;

generating a package to be provided to the client computer, the package comprising the supplemental metadata, the parent software update, the selected child software update and the selected second child software update.

2. The method of claim **1**, wherein the supplemental metadata identifies entities that produced the updates of the software program.

3. The method of claim **1**, wherein the supplemental metadata identifies processes performed in creating the updates of the software program.

4. The method of claim **1**, wherein the supplemental metadata identifies processes performed in testing the updates of the software program.

5. The method of claim **1**, wherein the supplemental metadata identifies an entity that certified the updates of the software program.

6. The method of claim **1**, wherein the supplemental metadata identifies processes performed in certifying the updates of the software program.

7. The method of claim **1** wherein the effect of the parent software update comprises one of an error in an operation of the operating system component and adding a new feature to the first program comprising the operating system component.

8. An apparatus comprising:

a processing device; and

a storage device having stored therein instructions which, when executed by the processing device, cause the processing device to:

receive update information and supplemental data associated with the update information for a plurality of software programs comprising a first software program provided by a first vendor among a plurality of vendors and a second software program provided by a second vendor among the plurality of vendors, wherein the first vendor is distinct from the second vendor, wherein the first software program comprises an operating system component, wherein the second software program comprises an application, wherein the application complements operation of the operating system component, and wherein the update information comprises dependency information regarding the application being dependent on updates to the operating system component;

determine, by the server system, a dependency of the application on a parent software update to the operating system component in view of the dependency information;

receive a request from a client computer for updates to the operating system component at the client computer and the supplemental data, wherein the parent software update is responsive to fulfilling the request for updates to the operating system component at the client computer;

determine an effect of the parent software update on the application at the client computer in view of the dependency information;

select a child software update that compensates the determined effect of the parent software update on the application at the client computer, wherein the second vendor provides the child software update and the first vendor provides the parent software update;

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select a second child software update that compensates the determined effect of the parent software update on the application at the client computer, wherein a third vendor among the plurality of vendors provides the second child software update, wherein the third vendor is distinct from the first vendor and the second vendor, wherein the third vendor provides a third software program from the update information for the plurality of software programs, wherein the third software program comprises a second application, wherein the second application complements operation of the operating system component;

generate a package to be provided to the client computer, the package comprising the supplemental metadata, the parent software update, the selected child software update and the selected second child software update.

9. A non-transitory computer-readable medium comprising instructions which, when executed by a processing device, cause the processing device to perform operations comprising:

receiving, by the processing device at a server system, update information and supplemental data associated with the update information for a plurality of software programs comprising a first software program provided by a first vendor among a plurality of vendors and a second software program provided by a second vendor among the plurality of vendors, wherein the first vendor is distinct from the second vendor, wherein the first software program comprises an operating system component, wherein the second software program comprises an application, wherein the application complements operation of the operating system component, and wherein the update information comprises dependency information regarding the application being dependent on updates to the operating system component;

determining, by the server system, a dependency of the application on a parent software update to the operating system component in view of the dependency information;

receiving, by the server system, a request from a client computer for updates to the operating system component at the client computer and the supplemental data, wherein the parent software update is responsive to fulfilling the request for updates to the operating system component at the client computer;

determining, by the server system, an effect of the parent software update on the application at the client computer in view of the dependency information;

selecting, by the server system, a child software update that compensates the determined effect of the parent software update on the application at the client computer, wherein the second vendor provides the child software update and the first vendor provides the parent software update;

selecting, by the server system, a second child software update that compensates the determined effect of the parent software update on the application at the client computer, wherein a third vendor among the plurality of vendors provides the second child software update, wherein the third vendor is distinct from the first vendor and the second vendor, wherein the third vendor provides a third software program from the update information for the plurality of software programs, wherein the third software program comprises a second application, wherein the second application complements operation of the operating system component;

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generating a package to be provided to the client computer, the package comprising the supplemental metadata, the parent software update, the selected child software update and the selected second child software update.

10. A method comprising:

receiving, by a processing device at a server system, a package comprising update information and supplemental metadata associated with the update information for a plurality of software programs comprising a first software program provided by a first vendor among a plurality of vendors and a second software program provided by a second vendor among the plurality of vendors, wherein the first vendor is distinct from the second vendor, wherein the first software program comprises an operating system component, wherein the second software program comprises an application, wherein the application complements operation of the operating system component, and wherein the update information comprises dependency information regarding the application being dependent on updates to the operating system component;

determining, by the server system, a dependency of the application on a parent software update to the operating system component in view of the dependency information;

receiving, by the server system, a request from a client computer for updates to the operating system component at the client computer and the supplemental metadata, wherein the parent software update is responsive to fulfilling the request for updates to the operating system component at the client computer;

determining, by the server system, an effect of the parent software update on the application at the client computer in view of the dependency information;

selecting, by the server system, a child software update that compensates the determined effect of the parent software update on the application at the client computer, wherein the second vendor provides the child software update and the first vendor provides the parent software update;

selecting, by the server system, a second child software update that compensates the determined effect of the parent software update on the application at the client computer, wherein a third vendor among the plurality of vendors provides the second child software update, wherein the third vendor is distinct from the first vendor and the second vendor, wherein the third vendor provides a third software program from the update information for the plurality of software programs, wherein the third software program comprises a second application, wherein the second application complements operation of the operating system component; and

certifying the package comprising the supplemental metadata, the parent software update, the selected child software update and the selected second child software update.

11. The method of claim 10, further comprising identifying from the supplemental metadata an entity that produced the package comprising the updates of the software program.

12. The method of claim 10, further comprising identifying from the supplemental metadata processes performed in creating the package comprising the updates of the software program.

13. The method of claim 10, further comprising identifying from the supplemental metadata processes performed in testing the package comprising the updates of the software program.

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14. The method of claim 10, further comprising identifying from the supplemental metadata an entity that certified the package comprising the updates of the software program.

15. The method of claim 10, further comprising identifying from the supplemental metadata processes performed in certifying the package comprising the updates of the software program.

16. An apparatus comprising:

a processing device; and

a storage device having stored therein instructions which, when executed by the processing device, cause the processing device to:

receive a package comprising update information and supplemental metadata associated with the update information for a plurality of software programs comprising a first software program provided by a first vendor among a plurality of vendors and a second software program provided by a second vendor among the plurality of vendors, wherein the first vendor is distinct from the second vendor, wherein the first software program comprises an operating system component, wherein the second software program comprises an application, wherein the application complements operation of the operating system component, and wherein the update information comprises dependency information regarding the application being dependent on updates to the operating system component;

determine a dependency of the application on a parent software update to the operating system component in view of the dependency information;

receive a request from a client computer for updates to the operating system component at the client computer and the supplemental metadata, wherein the parent software update is responsive to fulfilling the request for updates to the operating system component at the client computer;

determine an effect of the parent software update on the application at the client computer in view of the dependency information;

select a child software update that compensates the determined effect of the parent software update on the application at the client computer, wherein the second vendor provides the child software update and the first vendor provides the parent software update;

select a second child software update that compensates the determined effect of the parent software update on the application at the client computer, wherein a third vendor among the plurality of vendors provides the second child software update, wherein the third vendor is distinct from the first vendor and the second vendor, wherein the third vendor provides a third software program from the update information for the plurality of software programs, wherein the third software program comprises a second application, wherein the second application complements operation of the operating system component; and

certify the package comprising the supplemental metadata, the parent software update, the selected child software update and the selected second child software update.

17. A non-transitory computer-readable medium comprising instructions which, when executed by a processing device, cause the processing device to perform operations comprising:

receiving, by the processing device at a server system, a package comprising update information and supplemental metadata associated with the update information for a plurality of software programs comprising a first

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software program provided by a first vendor among a plurality of vendors and a second software program provided by a second vendor among the plurality of vendors, wherein the first vendor is distinct from the second vendor, wherein the first software program comprises an operating system component, wherein the second software program comprises an application, wherein the application complements operation of the operating system component, and wherein the update information comprises dependency information regarding the application being dependent on updates to the operating system component;

determining, by the server system, a dependency of the application on a parent software update to the operating system component in view of the dependency information;

receiving, by the server system, a request from a client computer for updates to the operating system component at the client computer and the supplemental metadata, wherein the parent software update is responsive to fulfilling the request for updates to the operating system component at the client computer;

determining, by the server system, an effect of the parent software update on the application at the client computer in view of the dependency information;

selecting, by the server system, a child software update that compensates the determined effect of the parent software update on the application at the client computer, wherein the second vendor provides the child software update and the first vendor provides the parent software update;

selecting, by the server system, a second child software update that compensates the determined effect of the parent software update on the application at the client computer, wherein a third vendor among the plurality of vendors provides the second child software update, wherein the third vendor is distinct from the first vendor and the second vendor, wherein the third vendor provides a third software program from the update information for the plurality of software programs, wherein the third software program comprises a second application, wherein the second application complements operation of the operating system component; and

certifying the package comprising the supplemental metadata, the parent software update, the selected child software update and the selected second child software update.

18. A method comprising:

receiving, by a processing device at a server system, a package comprising update information and supplemental metadata associated with the update information for a plurality of software programs comprising a first software program provided by a first vendor among a plurality of vendors and a second software program provided by a second vendor among the plurality of vendors, wherein the first vendor is distinct from the second vendor, wherein the first software program comprises an operating system component, wherein the second software program comprises an application, wherein the application complements operation of the operating system component, and wherein the update information comprises dependency information regarding the application being dependent on updates to the operating system component;

determining, by the server system, a dependency of the application on a parent software update to the operating system component in view of the dependency information;

receiving, by the server system, a request from a client computer for updates to the operating system component at the client computer and the supplemental metadata, wherein the parent software update is responsive to fulfilling the request for updates to the operating system component at the client computer;

determining, by the server system, an effect of the parent software update on the application at the client computer in view of the dependency information;

selecting, by the server system, a child software update that compensates the determined effect of the parent software update on the application at the client computer, wherein the second vendor provides the child software update and the first vendor provides the parent software update;

selecting, by the server system, a second child software update that compensates the determined effect of the parent software update on the application at the client computer, wherein a third vendor among the plurality of vendors provides the second child software update, wherein the third vendor is distinct from the first vendor and the second vendor, wherein the third vendor provides a third software program from the update information for the plurality of software programs, wherein the third software program comprises a second application, wherein the second application complements operation of the operating system component; and

managing an installation of the package comprising the supplemental metadata, the parent software update, the selected child software update and the selected second child software update.

19. The method of claim **18**, further comprising identifying from the supplemental metadata an entity that produced the package comprising the updates of the software program.

20. The method of claim **18**, further comprising identifying from the supplemental metadata processes performed in creating the package comprising the updates of the software program.

21. The method of claim **18**, further comprising identifying from the supplemental metadata processes performed in testing the package comprising the updates of the software program.

22. The method of claim **18**, further comprising identifying from the supplemental metadata an entity that certified the package comprising the updates of the software program.

23. The method of claim **18**, further comprising identifying from the supplemental metadata processes performed in certifying the package comprising the updates of the software program.

24. An apparatus comprising:
 a processing device; and
 a storage device having stored therein instructions which, when executed by the processing device, cause the processing device to:
 receive a package comprising update information and supplemental metadata associated with the update information for a plurality of software programs comprising a first software program provided by a first vendor among a plurality of vendors and a second software program provided by a second vendor among the plurality of vendors, wherein the first vendor is distinct from the second vendor, wherein the first software program comprises an operating system component, wherein the

second software program comprises an application, wherein the application complements operation of the operating system component, and wherein the update information comprises dependency information regarding the application being dependent on updates to the operating system component;

determine, by the server system, a dependency of the application on a parent software update to the operating system component in view of the dependency information;

receive a request from a client computer for updates to the operating system component at the client computer and the supplemental metadata, wherein the parent software update is responsive to fulfilling the request for updates to the operating system component at the client computer;

determine an effect of the parent software update on the application at the client computer in view of the dependency information;

select a child software update that compensates the determined effect of the parent software update on the application at the client computer, wherein the second vendor provides the child software update and the first vendor provides the parent software update;

select a second child software update that compensates the determined effect of the parent software update on the application at the client computer, wherein a third vendor among the plurality of vendors provides the second child software update, wherein the third vendor is distinct from the first vendor and the second vendor, wherein the third vendor provides a third software program from the update information for the plurality of software programs, wherein the third software program comprises a second application, wherein the second application complements operation of the operating system component; and

manage an installation of the package comprising the supplemental metadata, the parent software update, the selected child software update and the selected second child software update.

25. A non-transitory computer-readable medium comprising instructions which, when executed by a processing device, cause the processing device to perform operations comprising:
 receiving, by the processing device at a server system, a package comprising update information and supplemental metadata associated with the update information for a plurality of software programs comprising a first software program provided by a first vendor among a plurality of vendors and a second software program provided by a second vendor among the plurality of vendors, wherein the first vendor is distinct from the second vendor, wherein the first software program comprises an operating system component, wherein the second software program comprises an application, wherein the application complements operation of the operating system component, and wherein the update information comprises dependency information regarding the application being dependent on updates to the operating system component;

determining, by the server system, a dependency of the application on a parent software update to the operating system component in view of the dependency information;

receiving, by the server system, a request from a client computer for updates to the operating system component at the client computer and the supplemental metadata, wherein the parent software update is responsive to

fulfilling the request for updates to the operating system component at the client computer;
determining, by the server system, an effect of the parent software update on the application at the client computer in view of the dependency information; 5
selecting, by the server system, a child software update that compensates the determined effect of the parent software update on the application at the client computer, wherein the second vendor provides the child software update and the first vendor provides the parent software update; 10
selecting, by the server system, a second child software update that compensates the determined effect of the parent software update on the application at the client computer, wherein a third vendor among the plurality of vendors provides the second child software update, wherein the third vendor is distinct from the first vendor and the second vendor, wherein the third vendor provides a third software program from the update information for the plurality of software programs, wherein the third software program comprises a second application, wherein the second application complements operation of the operating system component; and 15 20
managing an installation of the package comprising the supplemental metadata, the parent software update, the selected child software update and the selected second child software update. 25

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